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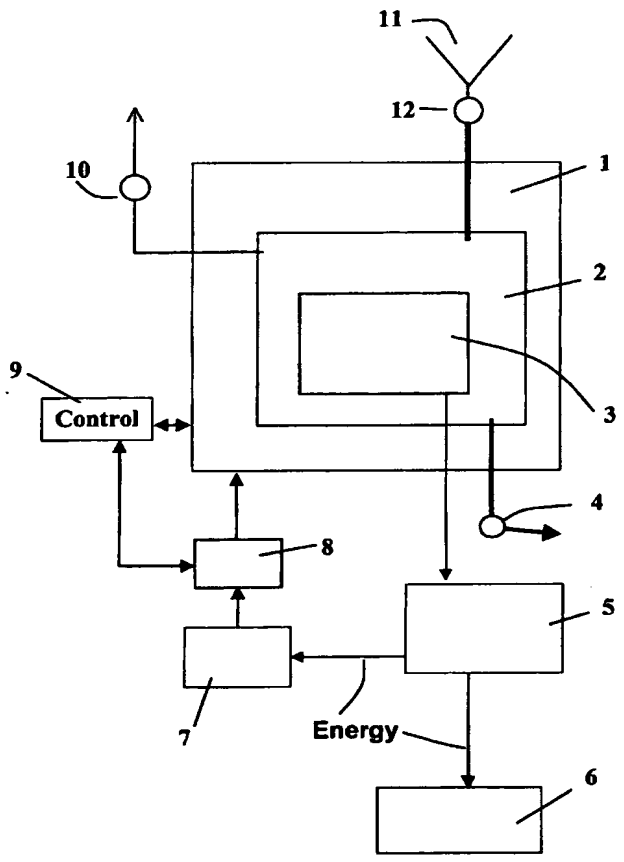
Declarations under Rule 4.17:
— *as to the identity of the inventor (Rule 4.17(i)) for all designations*
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for all designations*

[Continued on next page]

(54) Title: METHOD AND APPARATUS USING MICROWAVE ENERGY



(57) Abstract: The process generates energy from organic material utilizing microwaves. The waste from food item is dried and further heated under temperature control to convert it into a renewable source of energy. Enclosed in a glass chamber (2) it is then exposed to microwave energy. Apparatus comprises a microwave oven (1), a heat exchanger (3) and energy extraction systems (5) and (6). The microwave absorption creates an ionized hot air atmosphere of high-energy Plasma. This new process for hot plasma generates heat, pressure and electromotive energy, which can be converted by a heat exchanger; a microwave ignited internal-combustion engine or a Magneto-Hydrodynamic (MHD) system, to the useful form of mechanical or electrical energy. The process incorporates a method for plasma confinement to harness its energy. Suitable feedback-control (7) makes the process self-sustaining with net gain in the output energy. Energy efficiency of the process measures the nutritional value of food item used.

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— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii)) for all designations*
— *of inventorship (Rule 4.17(iv)) for US only*

Published:
— *with international search report*
— *with amended claims and statement*

Date of publication of the amended claims and statement:
2 September 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

AMENDED CLAIMS

[received by the International Bureau on 1st June 2004 (01.06.04)]

1. A method for converting, organic material (as hereinbefore defined) into a usable form of energy by means of microwaves, the method comprising the following steps:
(a) drying organic material by hot-air from conventional-oven or from an exhaust waste heat sources. It removes at least 80% of the moisture content whereby the dried organic material is converted into an energy storage form,

(b) Submitting the energy storage form to sufficient heat from conventional oven or from sources of waste heat to further alter its chemical composition into a fuel, and

(c) exposing the fuel to microwaves to convert the energy contained within the fuel into a usable form of energy selected from thermal, electrical, high pressure, a plasma, ionised air or gas and a fusion energy,

(d) whereby energy released is more than the input microwave energy and it is extracted by suitable means for further conversion.

2. The method according to Claim 1, wherein the energy storage form is carbonized, which can be stored for many days without any fermentation or natural deterioration.

3. The method according to Claim 1 or Claim 2, wherein the microwave operates at a frequency of 500MHz to 5000MHz and at a power of between 100W to 100 kW.

4. The method according to any one of the preceding claims, wherein the organic material is organic waste or fresh organic matter.

5. The method according to Claim 4, wherein the organic waste is selected from waste vegetables, fruits, skins of fruits, manure, compost and meat scraps.

6. The method according to Claim 1, wherein the fuel prepared at step (b) is exposed to microwaves at step (c) in the following manner:
(i) the prepared fuel is transferred to a glass chamber or a heat exchanger,
(ii) the glass chamber or heat exchanger is either transferred to, or preferably housed within a microwave cavity or microwave oven,

(iii) the microwave cavity or microwave oven is actuated whereby the prepared fuel is transformed into a flame or plasma of a temperature above 100°C.

7. The method Claim 6, wherein the prepared fuel is transformed into a blue flame or a plasma of a temperature above 400°C.

8. A method according to Claim 6, wherein the plasma is generated in the presence or absence of the plasma initiator, which comprises of a metal or non-metal or a compound of metal or non-metal.

9. The method of Claim 1, wherein the energy generated at step (c) is adapted for use in an internal combustion engine equipped with microwave igniters.

10. The method of claim 1, wherein the energy generated at step (c) is adapted to be used in a heating system or a cooling system.

11. The method of Claim 1, wherein a fraction of the output energy generated at step (c) is adapted to be fed-back for generating microwave, the continuous supply of fuel makes the process self-sustaining and/or continuous, whereby organic material in the form of fuel converts into energy.

12. The method of claim 1, wherein the energy generated at step (c) is adapted to be used to produce plasma or an ionised gas or air atmosphere, the plasma or ionised gas or air atmosphere being available for use in a Magneto Hydro-Dynamic (MHD) process.

13. The method of claim 6, wherein the glass chamber or heat exchanger is optionally fed by a gas or air stream.

14. The method of any one of Claims 6-13, wherein the fuel is exposed to microwaves under a switching or valve control such that the temperature and pressure generated is maintained within desired parameters.

15. The method of any one of Claims 6-14, wherein the steps are monitored to ensure that the conversion of energy from the organic material is maintained at a temperature and pressure in a sustainable and/or continuous manner.

16. The method of Claim 12, wherein the MHD process is adapted to generate electric power from plasma or the resultant ionised gas or air atmosphere either by using a permanent magnet or electromagnet or by inducing an electric current within a conductive coil such as copper.

17. A method according to any one of Claims 1-16, for use in a method of determining the energy value of an organic material, wherein the organic material has been prepared via steps (a) and (b) and exposed to microwaves at step (c), and wherein said material is transformed into a plasma, the properties of plasma generated and amount of energy released being a measure of the calorific value of the organic material.

18. A method according to Claim 17, wherein the plasma properties used for determining the energy value of the organic material are selected from (i) the colour of the plasma generated, (ii) the volume of the plasma generated, (iii) the air pressure generated, (iv) the temperature of the plasma generated and (v) the efficiency of the plasma generation.

19. A method according to Claim 6, wherein plasma generated at step (iii) is confined within the glass chamber or heat exchanger used at step (ii) and is available to be harnessed or extracted for further use.

20. A method according to Claim 19, wherein the further use is for an internal combustion engine, to drive a heating or cooling system, or to be further converted into thermal, electrical or high-pressure energy.

21. An apparatus useful in a method according to any one of the preceding claims comprising:

(a) a microwave cavity or microwave oven,

(b) housed within the microwave cavity or microwave oven is a glass chamber, or a heat exchanger,

(c) optionally an inlet for providing a gas or air stream, preferably heated, to the glass chamber or heat exchanger,

(d) a means for harnessing or extracting the thermal, electrical, high pressure, plasma, ionised gas or air, or fusion energy generated within the cavity,

(e) a means to feed-back a fraction of the output-energy to generate microwave, which makes the process self-sustaining on continuous basis and

(f) an outlet for exhaust gases.

22. An apparatus according to claim 21, wherein the means for harnessing the plasma or ionised gas or air, generated at step (c) of the method of Claim 1, comprises a coil of a conductive material such that when in contact with the plasma, the plasma is energised and rotates or vibrates thereby inducing an electric current inside the environment of the coil and wherein the current induction in the coil applies a reactive force thus confining the plasma and enabling the plasma to be harnessed.

23. An apparatus according to Claim 21 or 22 adapted for the confinement of plasma generated by a method according to any one of the preceding claims.

24. An apparatus according to Claim 21, wherein the gas stream is air or oxygen, or a combustible oxygen mix.

25. An apparatus according to Claim 21, adapted for fitment and use in an internal combustion engine, heating system and/or electrical generation system.

26. A method for converting organic material into a usable form of energy by means of microwaves according to Claim 1, substantially as hereinbefore described and exemplified with or without reference to the accompanying representations.

27. An apparatus for performing the method according to Claim 21, substantially as hereinbefore described and exemplified with or without reference to the accompanying representations.

Statement under Article 19(1)

The claims originally made with the description of the invention are amended to emphasize the novelty and the inventive step. The process specifically converts organic materials into a useful form of energy. Prior art does not exist to convert organic material into a useable form of energy using microwaves. The claim 1 now clearly states that drying and pre-processing of organic item is carried out by conventional heaters or from sources of waste heat. This improves energy efficiency and offers simple temperature control system.

Claim 1 (c) clearly states that microwave is used in the final stage of the process to obtain gain in the output energy, wherein the processed organic material is used as a fuel, which provides a source of renewable energy. Object of this invention is not just the disposal of garbage.

Prior-art apparatus incinerate waste material or garbage by microwaves for its disposal. These methods basically reduce garbage volume, consume large amount of electricity and do not generate net energy output. Garbage/ refuse include items which do not directly absorb microwaves, such items reduce the effective temperature and the process efficiency.

As per claim 17, intensity of the generated plasma is a measure of calorific value of the organic material used. Selection of correct organic material is important to achieve better energy efficiency. Thus, the process also provides a method to determine the energy value of a given food or organic item.

Different items like skins of banana, apple, potato etc. were used for experiments. After undergoing through the invented process, some items generate greater plasma energy and heat than others. Process time in the microwave can be as low as 2 to 10 seconds. Less processing time makes the energy conversion process very efficient.

Claim 21 amended to emphasize, that the invention is the design of apparatus for energy generation / extraction and to achieve a self-sustaining process.

Garbage incinerators do not have any system for energy extraction. Even if an energy extraction is included, there is no gain in the net energy output. Incinerator is designed to

reduce the volume of waste for easier disposal. Microwave absorbing shrouds and elements within an incinerator prevent plasma generation.

As per the claims of the applicant's invention, the method provides an apparatus to convert food and organic materials into a useful form of energy. Heat from waste exhaust sources is used for drying process and microwave generates hot plasma energy from the processed organic material, which becomes a renewable fuel. Energy output is more than the microwave energy input. Different methods of energy extraction converts plasma into a useful form of energy.

Unique method as per claim 16 and 22 controls and confines the plasma for optimum energy extraction. A feedback system as per claim 11 makes the process self-sustaining and continuous with the continuous supply of processed organic material.

The amendment of claims does not have any impact on the drawings and the description.

INTERNATIONAL SEARCH REPORT

International application No.
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A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: B01J 19/12, C10L 5/00, F23G 5/00, H05B 6/80, H05H 1/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC REFER ELECTRONIC DATA BASE CONSULTED

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DWPI IPC B01J 19/12, C10L 5/00, F23G 5/00, H05B 6/80, H05H 1/46 & Key words (microwave, food, organic, compost, waste, refuse)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4937411 A (Suzuki et al) 26 June 1990 whole document	1-27
X	US 5886326 A (Tang) 23 March 1999 whole document	1-27
A	WO 1994/18286 A (Holland) 18 August 1994	

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 March 2004	- 8 APR 2004
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer **ASOKA DIAS-ABEYGUNAWARDENA** Telephone No : (02) 6283 2141

INTERNATIONAL SEARCH REPORT

International application No.
PCT/NZ2003/000276

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
US	4937411	EP	0318598	JP	1058919	JP	1163514
		JP	63318410	WO	8810399		
US	5886326						
WO	9418286	AU	59754/94	BR	9406342	CA	2153808
		EP	0682685	FI	953674	GB	2289476
		MX	9400937	NO	952652	PL	309696
		SG	48721				

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